Part-Time Entrepreneurship and Wealth Effects: New Evidence from the Panel Study of Entrepreneurial Dynamics*

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Abstract

Why do people become part-time entrepreneurs? Are they credit-constrained? Previous studies on entrepreneurship do not deal with part-timers, that is, workers who devote some of their time to self employment and some of their time to working for wages. In contrast, a recent survey on the establishment of new businesses reports that 80 percent of nascent entrepreneurs also hold regular wage jobs. I develop a model of entrepreneurial choice in which individuals decide not only how much capital to invest, but also what proportion of time to spend in business. The model allows me to test whether entrepreneurs are credit-constrained. I use a new and unique data set that looks at how nascent entrepreneurs divide their time between their own businesses and other jobs. My empirical findings show that part-time entrepreneurs do not appear to be constrained. This is not to say that no entrepreneur is credit-constrained. It might be that a lot of part-time business owners operate in less capital intensive sectors. Instead, the result points to the marginal entrepreneur. If credit constraints are crucial, wealthier entrepreneurs should shift their time a lot more into their businesses, because the credit constraints would have been relaxed.

JEL code: M13
Keywords: Start-ups, Entrepreneurship, Liquidity Constraints

*Acknowledgments: I am grateful to Peter Gottschalk, Donald Cox, Ingela Alger, Nikolay Markov, and Viktors Stebunovs for useful suggestions and creative criticism. I would like to thank Boyan Jovanovic and participants in the ICSB world conference for helpful discussion. All existing errors are my responsibility.

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1 Introduction

New businesses often rely on individual and household wealth as a source of start-up capital, financial security, or insurance for acquiring funds (Gartner et al. 2004). This suggests that assets have a crucial effect on the level of entrepreneurial activity. In their seminal studies, Evans and Jovanovic (1989), Dunn and Holtz-Eakin (1994), and Holtz-Eakin et al. (1994) find empirical evidence that entrepreneurs are credit-constrained, and that wealthy people, who are better able to obtain substantial amounts of initial capital, are more likely to be involved in entrepreneurial activities. Hurst and Lusardi (2004), however, show that wealth effects are significant only for the top 5 percent of the wealth distribution. In this paper, I examine the effect of initial wealth on the tendency to participate in a business start-up for part-time entrepreneurs and argue that wealth does not significantly affect the propensity to become an entrepreneur.

Part-time entrepreneurs are people who work a regular wage job some of the time and work at their own businesses the other part of the time. Why are there these part-time entrepreneurs? Why don't they just devote all their time to their own businesses? One hypothesis for the existence of part-time entrepreneurship is that people are credit-constrained. They would like to borrow enough to build their businesses and put food on the table during the early years when the enterprise is still small and not yet generating very much cash. If they cannot borrow, the only way they can get money to pay their bills is to work at a regular job.

Early studies on entrepreneurship do not deal with part-timers. Instead, they use self-employment as a proxy for entrepreneurship and focus on the selection into self-employment and the effect of different factors on it. These studies employ data from labor market surveys that treat respondents as either self-employed or wage workers and that do not allow the two groups to overlap. Do we have to worry about part-time entrepreneurs? Recent evidence from a large cross-national study on the level of entrepreneurial activity (*Global Entrepreneurship Monitor*, 2003 Executive Report) has established that 80 percent

of those who implement start-ups also hold regular wage jobs. These findings conflict with the theories of entrepreneurial choice in which individuals choose only between outside paid jobs and self-employment, and in which the complexity of entrepreneurial activity is not reflected.

In this study, I develop a model of entrepreneurial choice in which individuals decide how much capital to invest and what proportion of time to spend in business. To examine the importance of credit constraints, I estimate a reduced-form probit model. The probability of starting a new business and wealth would be positively correlated if and only if there are credit constraints. Wealth, however, is likely to be endogenous: what helps people become wealthy might be the same quality responsible for their unobservable entrepreneurial talent. To deal with wealth endogeneity, I propose a new method for instrumenting wealth. I use month-to-month changes in the Standard & Poor 500 stock market index that serve as a source of assets variation exogenous to entrepreneurial decisions.

I test the wealth hypothesis using data from the Panel Study of Entrepreneurial Dynamics. The PSED is an extensive nationally representative survey of the establishment of new businesses reporting that 50 percent of nascent entrepreneurs have full-time work and 20 percent have part-time wage and salary work outside the start-ups. This new and unique data set provides detailed information on how nascent entrepreneurs divide their time between their own businesses and other jobs.

My empirical findings show that part-time entrepreneurs do not appear to be constrained. In my regressions, where on the left-hand side is an indicator of either being an entrepreneur or being a wage worker, and on the right-hand side (along with other controls) is wealth, the wealth variable is not significantly different from zero. This is not to say that no entrepreneur is credit-constrained. Instead, the result points to the effect of wealth on the marginal entrepreneur. The intuition is based upon the role of wealth. If credit constraints are crucial, wealthier entrepreneurs should shift their time much more into their businesses, because the credit constraints would have been relaxed.

2 Related Literature

My theoretical model is closely related to Evans and Jovanovic (EJ) (1989). EJ present a static model of self-employment choice where selection into self-employment is based on entrepreneurial ability and liquidity constraints.[1] They estimate the parameters of the entrepreneurial ability distribution and find empirical evidence that wealth influences the tendency to become an entrepreneur. EJ conclude that capital constraints are binding: those with less initial capital are less likely to become entrepreneurs.

In an extended version of EJ, Xu (1997) replaces the static model with a two-period model, in which individuals make occupational choices to maximize their life-time consumption. Both EJ and Xu assume risk-neutrality. The two models, however, differ in their predictions about the correlation between entrepreneurial ability and individual net worth. EJ show a negative correlation, whereas Xu argues that a negative correlation is theoretically implausible, since entrepreneurs would accumulate capital in advance if they were to expect financial constraints.

Instrumental Variable (IV) methods have been used in earlier studies to evaluate the effect of wealth on the propensity to become an entrepreneur. Blanchflower and Oswald (1990) and Holtz-Eakin et al. (1994) exploit inheritances and inherited businesses as instrumental variables to evaluate the effect of wealth on the probability of becoming self-employed. Both studies find a strong and statistically significant positive effect. Inheritances, however, are not a good choice for instrumenting wealth effects. For example, Hurst and Lusardi (2004) show that both past and future inheritances affect the propensity to become self-employed. In addition, there is still an endogeneity concern. Individuals who receive inheritances might have different talent and abilities, hence different entrepreneurial propensities, than those who do not receive inheritances. Hurst and Lusardi use as an instrument, instead, variation

[1] Other studies are Blanchflower and Oswald 1990, Evans and Leighton 1989, Holtz-Eakin, Joulfaian, and Rosen 1994, Cressy 1996, and more recently Xu 1998, and Hurst and Lusardi 2004. All of them include empirical work that relies extensively on household surveys, where respondents are classified as either self-employed or wage/salary workers.

in liquidity due to regional differences in housing appreciation. They find that wealth effects are statistically significant but only for the top 5 percent of the wealth distribution. I propose a new method for instrumenting wealth. I use month-to-month changes in the Standard & Poor 500 stock market index that serve as a source of assets variation exogenous to entrepreneurial decisions.

3 Theoretical Background

3.1 The Model

I extend the Evans and Jovanovic model of entrepreneurial choice under liquidity constraints by introducing part-time entrepreneurship. Once new business owners with outside jobs are allowed into the definition of entrepreneurs, the propensity to participate in a start-up becomes a function of individual assets, unobservable entrepreneurial ability, and preference for participation in multiple labor-force activities. I also apply the two-period extension with endogenously determined wealth proposed by Xu. Individuals are risk-neutral and differ in their entrepreneurial ability θ, which they know ahead of time.[2] There is no wealth endowment, and all individuals are wage workers in period 1. At the end of period 1 they receive annual wage income w that is divided into consumption c_1 and savings z. Individuals make occupational choices in order to maximize lifetime consumption. Entrepreneurial choice occurs in period 2.

The period-2 income for a full-time wage worker is $w + rz$, where r is the (gross) interest rate. The lending and borrowing rates are assumed to be equal. The period-2 income for a full-time entrepreneur is $y(k, \delta) + r(z - k)$. $y(k, \delta)$ is the entrepreneurial production function, where k is the amount of capital invested and δ is the proportion of time spent in the start-

[2]Keeping the assumption of risk-aversion would require investigating the connection between risk attitude and propensity to become an entrepreneur; this relationship is beyond the scope of the discussion. Kihlstrom and Laffont (1979) investigate the effect of risk aversion on entrepreneurial decisions in detail. The difference between the current set-up and the theory developed in the previous section is that here entrepreneurs know their ability ahead of time.

up, $0 \leqslant \delta \leqslant 1$. Individuals, however, can work in full- or part-time outside jobs and also choose to be involved in a start-up. The total amount of hours spent in work activities is fixed and normalized to 1.

If the amount of savings is less than the capital necessary for investment, $z < k$, the entrepreneur needs to borrow additional capital, and $r(z-k)$ is the amount of money that he repays at the end of the period. Following EJ, I assume that an individual can borrow only up to a certain amount, $(\lambda - 1)z$, which is proportional to his savings. $\lambda - 1$ is the factor of proportionality, $\lambda \geqslant 1$. The greatest amount of capital that can be invested is $z + (\lambda - 1)z = \lambda z$, and the constraint is $0 \leqslant k \leqslant \lambda z$.

3.2 The Entrepreneurial Production Function

The entrepreneurial production function is defined as:

$$y = \theta k^{\alpha} \delta^{\beta}, \tag{1}$$

where k is the amount of capital invested in the start-up and $\alpha + \beta < 1$.

The distinctive feature in the above definition is the decreasing returns to scale. This assumption has been employed since the general equilibrium analysis conducted by Lucas (1978) and repeteadly reappeared in Evans and Jovanovic (1989), Holtz-Eakin, Joulfaian and Rosen (1994), Cressy (1996), Dunn and Holtz-Eakin (2000), Gentry and Hubbard (2000). Using data on new Japanese firms, Harada (2004) examines the validity of this assumption, and finds empirical evidence that the entrepreneurial production function exhibits decreasing returns to scale. This result suggests that there is a rent from entrepreneurial ability.

The period-2 net income for an entrepreneur is[3]

$$\begin{aligned} \pi(k, \delta; \theta) &= \theta k^{\alpha} \delta^{\beta} + r(z-k) + (1-\delta)w \\ &= (\theta k^{\alpha} \delta^{\beta} - rk - \delta w) + rz + w. \end{aligned} \tag{2}$$

[3]In EJ and Xu, w is not a part of the entrepreneur's net income, because every individual is either an entrepreneur or a wage worker, but not both.

When $\delta = 1$, the net entrepreneurial income becomes $\pi(k;\theta) = \theta k^{\alpha} + r(z-k)$, as in the basic EJ model. For those individuals who do not choose entrepreneurship in period 2, and who continue with their wage jobs, $\pi(k;\theta)$ is equal to $rz + w$.

3.3 Entrepreneurial Decision

In the second stage, the entrepreneur's desired investment and time spent in the start-up are obtained by maximizing his net income with respect to k and δ.

$$\underset{0\leqslant\delta\leqslant 1,\ k\geqslant 0}{max}\ \pi(k,\delta;\theta) = \theta k^{\alpha}\delta^{\beta} + r(z-k) + w(1-\delta) \tag{3}$$

The Lagrangian for this maximization problem is:

$$\pounds = \theta k^{\alpha}\delta^{\beta} + r(z-k) + w(1-\delta) - \mu_1(\delta - 1) + \mu_2\delta + \mu_3 k. \tag{4}$$

The optimal solution can be an interior solution when individuals choose to be part-time entrepreneurs, or a corner solution when they are either full-time entrepreneurs or wage workers. Hence, there are three possible outcomes described in the following proposition:

Proposition 1: Let $\pi(k,\delta;\theta) = \theta k^{\alpha}\delta^{\beta} + r(z-k) + w(1-\delta)$ be the entrepreneurial's net income, maximized with respect to k and δ, where $0 \leqslant \delta \leqslant 1$ and $k \geqslant 0$. Then, the solution to the optimization problem is:

$$\text{Full-time entrepreneur: } (k^*,\delta^*) = \left\{ \left(\frac{\theta\alpha}{r}\right)^{\frac{1}{1-\alpha}}, 1 \right\} \text{ for } \theta \geqslant \left(\frac{r}{\alpha}\right)^{\alpha}\left(\frac{w}{\beta}\right)^{1-\alpha}$$

$$\text{Part-time entrepreneur: } (k^*,\delta^*) = \{A, B\} \text{ for } 0 < \theta < \left(\frac{r}{\alpha}\right)^{\alpha}\left(\frac{w}{\beta}\right)^{1-\alpha}$$

$$\text{Wage worker: } (k^*,\delta^*) = \{0,0\} \text{ for } \theta = 0$$

where $A = \theta^{\frac{1}{1-\alpha-\beta}}\left(\frac{\alpha}{r}\right)^{\frac{1-\beta}{1-\alpha-\beta}}\left(\frac{\beta}{w}\right)^{\frac{\beta}{1-\alpha-\beta}}$ and $B = \theta^{\frac{1}{1-\alpha-\beta}}\left(\frac{\alpha}{r}\right)^{\frac{\alpha}{1-\alpha-\beta}}\left(\frac{\beta}{w}\right)^{\frac{1-\alpha}{1-\alpha-\beta}}$.

Proof of Proposition 1 is provided in Appendix.

Since the focus of this study is individuals who become part-time entrepreneurs, I will proceed further with a discussion of the interior solution only and the choice under liquid-

ity constraints. The corner solutions of the problem, together with the effect of capital constraints and the choice between full-time entrepreneurship and full-time wage work, are discussed in details in EJ.

From Proposition 1, the optimal levels of capital invested and time spent in business in the case of part-time entrepreneurship are determined as:

$$k^* = \theta^{\frac{1}{1-\alpha-\beta}} \left(\frac{\alpha}{r}\right)^{\frac{1-\beta}{1-\alpha-\beta}} \left(\frac{\beta}{w}\right)^{\frac{\beta}{1-\alpha-\beta}}, \tag{5}$$

$$\delta^* = \theta^{\frac{1}{1-\alpha-\beta}} \left(\frac{\alpha}{r}\right)^{\frac{\alpha}{1-\alpha-\beta}} \left(\frac{\beta}{w}\right)^{\frac{1-\alpha}{1-\alpha-\beta}}. \tag{6}$$

The results in (5) and (6) indicate that for those who choose to become part-time entrepreneurs the outside wage is inversely related to both time spent in business and capital invested. Thus, when the outside wage increases, they will devote less time to their businesses since the opportunity cost of time in the start-up will be higher. One possible explanation for observing such an effect of a change in w on the amount of time spent in business might be that the substitution effect of an increase in the outside wage dominates the income effect. As a result, they will increase the time spent in the outside job.

An increase in the outside wage also affects the amount of capital invested. Individuals will invest less capital, because less time devoted to business implies a lower marginal product of capital.

From the optimal solution for δ in (6), the amount of time that a part-time entrepreneur spends in business is positively correlated with his ability. Or, successful entrepreneurs will divert more time to their business than those who have less talent. Similarly, from (5), better entrepreneurs will invest more capital and will, therefore, save more in the first period.

3.4 Capital Constraints

A part-time entrepreneur is financially unconstrained if $k \leqslant \lambda z$:

$$\theta^{\frac{1}{1-\alpha-\beta}} \left(\frac{\alpha}{r}\right)^{\frac{1-\beta}{1-\alpha-\beta}} \left(\frac{\beta}{w}\right)^{\frac{\beta}{1-\alpha-\beta}} \leqslant \lambda z, \tag{7}$$

or his θ must satisfy

$$\theta \leqslant (\lambda z)^{1-\alpha-\beta} \left(\frac{r}{\alpha}\right)^{1-\beta} \left(\frac{w}{\beta}\right)^{\beta}. \tag{8}$$

Otherwise, the entrepreneur is constrained.

In addition, from (6), $0 < \theta^{\frac{1}{1-\alpha-\beta}} \left(\frac{\alpha}{r}\right)^{\frac{\alpha}{1-\alpha-\beta}} \left(\frac{\beta}{w}\right)^{\frac{1-\alpha}{1-\alpha-\beta}} < 1$, or

$$0 < \theta < \left(\frac{r}{\alpha}\right)^{\alpha} \left(\frac{w}{\beta}\right)^{1-\alpha}. \tag{9}$$

By combining (8) and (9), I receive the following condition on θ for an unconstrained entrepreneur:

$$0 < \theta < \min\left((\lambda z)^{1-\alpha-\beta} \left(\frac{r}{\alpha}\right)^{1-\beta} \left(\frac{w}{\beta}\right)^{\beta}, \left(\frac{r}{\alpha}\right)^{\alpha} \left(\frac{w}{\beta}\right)^{1-\alpha}\right). \tag{10}$$

In the case when there are no constraints and $\lambda = \infty$, (10) transforms back to the original condition $0 < \theta < \left(\frac{r}{\alpha}\right)^{\alpha} \left(\frac{w}{\beta}\right)^{1-\alpha}$.

For a constrained entrepreneur $k > \lambda z$ and the resulting condition on θ is:

$$(\lambda z)^{1-\alpha-\beta} \left(\frac{r}{\alpha}\right)^{1-\beta} \left(\frac{w}{\beta}\right)^{\beta} < \theta < \left(\frac{r}{\alpha}\right)^{\alpha} \left(\frac{w}{\beta}\right)^{1-\alpha}. \tag{11}$$

The above condition holds only if the left hand side of (11) is smaller than the right hand side. (11) can be rewritten as

$$\left(\frac{\lambda z}{\frac{w}{r}\frac{\alpha}{\beta}}\right)^{1-\alpha-\beta} < \theta < 1, \tag{12}$$

where $\frac{w}{r}\frac{\alpha}{\beta}$ is the inverse of the optimal input factor ratio. Thus, $\lambda z < \frac{w}{r}\frac{\alpha}{\beta}$ would be enough to assure that (12) is correctly specified.

3.5 Occupational Choice

Individuals make occupational choices in order to maximize lifetime consumption. I assume that every individual knows the value of his θ before committing to entrepreneurship. The present value of the lifetime consumption of an entrepreneur (over two periods) is given by:

$$V = c_1 + \frac{\theta k^{\alpha}\delta^{\beta} + r(z-k) + w(1-\delta)}{r}, \tag{13}$$

where $c_1 = w - z$ is the period-1 consumption.

For an entrepreneur who is financially constrained $k = \lambda z$. Thus, V can be rewritten as:

$$V = w + \frac{\theta(\lambda z)^{\alpha}\delta^{\beta}}{r} - \lambda s + \frac{w(1-\delta)}{r}. \tag{14}$$

The first-order condition of maximizing V with respect to z is

$$z^* = \frac{1}{\lambda}\left(\frac{\theta\alpha\delta^{\beta}}{r}\right)^{\frac{1}{1-\alpha}} = \theta^{\frac{1}{1-\alpha-\beta}}\left(\frac{\alpha}{r}\right)^{\frac{1-\beta}{1-\alpha-\beta}}\left(\frac{\beta}{w}\right)^{\frac{\beta}{1-\alpha-\beta}}. \tag{15}$$

Thus, wealth and ability are positively correlated for financially constrained part-time entrepreneurs. For unconstrained entrepreneurs, $V = w - z + \frac{\theta k^{*\alpha}\delta^{*\beta} - rk^* + w(1-\delta^*)}{r}$, or there is no correlation between wealth and ability. This result is similar to Xu, but differs from EJ who show that there is a negative correlation between ability and wealth. If individuals know their entrepreneurial ability ahead of time and expect financial difficulties, they will accumulate funds before making entrepreneurial decisions.

One can see from Proposition 1 that the distribution of ability θ also depends on the parameters of the entrepreneurial production function α and β. Entrepreneurs who are involved in more capital intensive businesses will save more than those involved in businesses that need a lower amount of starting capital. Thus, the amount of capital invested will differ across industries and sectors.

3.6 Empirical Implications

Using the conditions on the distribution of ability one can write down the corresponding likelihood of becoming an entrepreneur in the presence of part-time entrepreneurship and

estimate the parameters of the joint distribution of ability and wealth. The sign and magnitude of the coefficient on λ would be crucial for assessing the importance of financial constraints.

Alternatively, one can apply a simple test of the model using reduced-form results. Under the assumption that wealth and entrepreneurial ability are uncorrelated, the theoretical model has the following implication: the probability of starting a new business and wealth are positively correlated if and only if there are credit constraints. An entrepreneur who is wealthier should shift his time a lot more into his business as a result, because the credit constraints would have been relaxed. He can buy machinery, feed himself and still devote all his time to investing in his business.

4 Empirical Model and Estimation

In this section, I present estimates of the causal effect of wealth on entrepreneurial propensity. A linear approximation to the propensity to participate in entrepreneurial activities is given by $E_i^* = \alpha' X_i + \gamma wealth_i + \varepsilon_i$. E^* is not observed, but individuals report whether they are currently involved in the creation of a start-up. I denote $E_i = 1$ if individual i participates in entrepreneurial activity, and $E_i = 0$ otherwise. Thus, the probability to become an entrepreneur is $\Pr[E_i = 1|X_i] = \Pr(\varepsilon_i > -\alpha' X_i - \gamma wealth_i)$, and the model to be estimated is:

$$E_i^* = \alpha' X_i + \gamma wealth_i + \varepsilon_i \tag{16}$$

$$E_i = 1\left[E_i^* > 0\right], \tag{17}$$

where ε is normally distributed.

Assuming that ε is normally distributed, the probability of becoming an entrepreneur can be estimated as a function of wealth and characteristics X (gender, race, education, marital status, involvement in work activities, experience, and age) using probit regression.

Wealth is likely to be correlated with the error term in the probit equation since unobservable factors may affect both wealth and the likelihood of becoming an entrepreneur. One such unobservable factor could be the individual's ability to accumulate wealth related to some special talent. The same ability may be responsible for starting new business. If this is true, the error term ε and *wealth* are correlated.[4] I use a probit instrumental variable model. The instrumental variable approach is discussed in detail in the following subsection.

4.1 Endogeneity of Household Wealth

A consistent estimate of the effect of wealth on the propensity to become an entrepreneur can still be obtained if a set of variables Z that are correlated with wealth but not ε, the error term in the entrepreneurial propensity equation, can be identified. Given Z, we can calculate the IV estimate of the effect of wealth on the propensity to become an entrepreneur.

I use stock market changes as a source of assets variation exogenous to entrepreneurial decisions. My IV method exploits the fact that the variation in savings during Wave 1 of PSED data collection (1998-2000) captures the rapid stock market movements that occurred in the second half of 1998. I instrument wealth with month-to-month changes in S&P 500 for the period of 1998-2000. This IV method exploits the stock wealth effect, and specifically the exogenous variations in savings and investments, as part of wealth.

One might argue that stock market fluctuations reflect changes in the opportunities to become an entrepreneur. This would happen in two cases. First, it would happen if entrepreneurial activities focus mainly on investments on the stock market. However, the PSED covers entrepreneurs based on strict criteria (described in the data section of the paper). According to these criteria, individuals are included in the sample only if they spend time in functioning businesses or are establishing such businesses, and if they invest capital in their start-ups. Also, the entrepreneurs in the sample must have been in business for at least the past 12 months. A second case will be if the stock market changes cover a

[4]Similar to a linear regression, a correlation between a regressor and the error term violates the assumption behind the nonlinear regression model.

period of time longer than one month. For example, individuals might have accumulated funds as a result of earlier luck on the stock market, or alternatively, lost part of their wealth. In addition, earlier changes on the stock market might have affected the business climate in general. All these won't affect my instrument because I use changes in S&P 500 that occur at the time of observation, and not at the time when the start-up begins functioning. And further, the data shows that in most of the cases the start-up (business) ideas date much earlier than 1998. Hence, the stock market changes from the period of 1998-2000 have no way of affecting the entrepreneurial opportunities in this case. In other words, the incidence of becoming an entrepreneur is not correlated with the current changes on the stock market and the economy as a whole.

Wealth has the following reduced form:

$$wealth_i = \xi^{'} X_i + \beta' Z_i + u_i, \tag{18}$$

where (ε, u) has a zero mean, bivariate normal distribution and is independent of Z. X is the same set of variables that appeared in the entrepreneurial propensity equation, and Z is the set of variables mentioned above, correlated with wealth but not with the error term in the entrepreneurial propensity equation.

In this study, the instrument Z is the month-to-month percentage change of annual rates in the S&P500 stock market index. Figure 5 and Figure 6 in Appendix present the S&P 500 and the month-to-month percentage change of annual rates in S&P500 for the period of 1998-2004. A sharp downturn spike can be observed in the second half of 1998. There is also a lot of monthly variation.

Changes in the stock market, as measured by different indexes, affect households' accumulation of savings and investments (stocks, bonds, mutual funds, etc.). Savings and investments, however, are part of the household net worth. The identifying assumption that I need in order to apply this instrument is that the index changes are correlated with household savings but are not correlated with, the residual in the latent variable model

determining the probability to become an entrepreneur.

4.2 Estimating a Probit Instrumental Variable Model

I estimate a probit IV regression using the technique for efficient estimation of limited dependent variable models with endogenous explanatory variables in the presence of normally distributed disturbances. The technique was proposed by Newey (1987). Rivers and Voung (1987) consider the limited information simultaneous system explicitly for probit estimations. While the Newey method is asymptotically more efficient, the Rivers and Voung approach is a computationally simple test of endogeneity of wealth (savings). The standard errors for probit models with IV have been corrected for estimation in the first stage following Murphy and Topel (1985), with the use of a two-step estimation procedure.

The Rivers and Voung procedure is as follows. Under the joint normality of (ε, u), with variance $Var(\varepsilon) = 1$ from the propensity equation, ε can be rewritten as $\varepsilon = \eta u + e$, where $\eta = \frac{Cov(\varepsilon,u)}{Var(u)}$, and e is independent of Z and u, and therefore of s. e is also normally distributed with mean zero and variance $Var(e) = 1 - \rho^2$, where $\rho = Corr(\varepsilon, u)$. Thus,

$$E_i^* = \alpha^{'} X_i + \gamma s_i + \eta u + e \tag{19}$$

$$e \mid Z, s, u \tilde{} \; Normal(0, 1 - \rho^2). \tag{20}$$

I estimate first an OLS regression of s on Z and save the residuals $\widehat{u}$, and then run a probit equation of E on X, s, and $\widehat{u}$ to get consistent estimators of the scaled coefficients.

In the first stage of IV estimation, household savings and investments are regressed on the monthly changes in S&P500 and a set of exogenous covariates.[5] OLS is used on this stage.

A series of articles has been published (Bound, Jaeger, and Baker 1993, 1995) addressing

[5]Even though the second figure in Appendix 1 is given in percentage changes, the estimation in the first stage is based on changes only.

the problem of weak instruments.[6] These studies focus on two effects. First, a weak correlation between the instrument and the endogenous variable will exacerbate the small sample bias associated with a correlation between the instrument and the residual in the second-stage regression. Second, the magnitude of finite sample bias in IV estimates approaches that of the OLS bias as the R^2 between the endogenous variable and the instruments approaches zero. Bound, Jaeger, and Baker suggest that the R^2 and the F-statistics from the first stage of IV estimation be reported as approximate guides to the quality of the IV estimates. According to Staiger and Stock (1997), a value of 10 can be used as an approximation for the F-statistic associated with the hypothesis that the coefficients on the instruments in the first-stage regression of IV are jointly zero.

In the second stage, I estimate a probit model with a dependent variable that equals one for respondents identified as entrepreneurs and zero for the control group. The right-hand side includes savings and investments, the fitted residual from the first stage, and a set of demographic characteristics. The regressors from the second stage of IV are also included in the first stage. Including the fitted residuals from the first stage requires a standard errors correction as mentioned above, since the residual is an estimate.

5 Data: Panel Study of Entrepreneurial Dynamics

The empirical estimation is performed on data from the Panel Study of Entrepreneurial Dynamics (PSED), an extensive nationally representative survey of the establishment of new businesses. The PSED provides several innovations over previous data sets. First, the data were specifically created to follow both nascent entrepreneurs and start-ups. Nascent entrepreneurs are selected based on three criteria: being involved in a start-up for the past 12 months, expecting to be at least partial owners of the business, and functioning in the

[6]The studies that I mention here are specifically designed for linear models. However, they can still be used to evaluate the quality of instruments from the first stage of IV estimation, where OLS is used to regress savings and investments on the instruments.

gestation phase of the business. The third criterion determines whether "the start-up has a positive cash-flow that covers expenses and the owner-manager salaries for more than three months." Respondents with a positive cash-flow for more than three months are excluded.

Second, start-ups are followed for a period of four years. In this way, we can observe the effect of wealth and initial capital on the start-ups' performance and the rate of entrepreneurial survival. Third, every PSED wave includes observations that are made during a period of two to three consecutive years. For example, the Wave 1 data collection starts in July 1998 and ends in 2000; some respondents are interviewed in 1998, others in 1999, and a small portion is observed in 2000. This is beneficial for the analysis, since it allows taking advantage of the stock market changes over a longer period of time.

The PSED, designed to represent the entire population of entrepreneurs, consists of 830 nascent entrepreneurs and 431 comparison group members. The sample is randomly selected after an 8-month preliminary screening of 64,622 individuals at least 18 years old. Women, Blacks and Hispanics are oversampled. After the initial screening, two representative samples are identified. A sample of those attempting to start new businesses is identified based on the criteria described above. A second representative sample of typical adults, a control group, is constructed also. The next stage of data collection is the completion of phone interviews and mail questionnaires by both groups. The last stage is a 12- and 24-month follow-up phone interview and a mail questionnaire completed only by the entrepreneurs. In this study I use data from Wave 1, which is completed between 1998 and 2000. Wave 2 is the first follow-up completed 12 months after Wave 1. Wave 3 is the second follow-up after 24 months. Four waves have currently been completed.

Summary statistics of the variables used in the study are presented in Table 1 through Table 3. The data are described in detail in Gartner et al. (2004). The PSED sample weights are used in all estimations described in this paper.

I identify multiple work activities for every respondent: full-time work, part-time work, business owner or self-employed, or manager of business owned by others. There is an

interesting variation between nascent entrepreneurs and members of the control group. Both groups report that paid work dominates their time on workdays. However, "Personal time with spouse, others" is the third largest use of time for nascent entrepreneurs, whereas members of the control group report "reading, TV, sports, recreation, and hobbies, going out" as their third largest use.[7]

Table 1 Summary Statistics

Variable	Mean	Stand. Deviation
Age	40.1	(12.5)
White	0.762	(0.426)
Male	0.570	(0.495)
Education		
Less than high school	0.035	(0.185)
High school	0.233	(0.423)
Some college	0.374	(0.484)
College or more	0.356	(0.479)
Married	0.649	(0.477)
Experience	17.6	(11.2)
Outside job	0.920	(0.272)
Entrepreneur	0.629	(0.483)
HH Net Worth x 10^{-6}	0.206	(0.659)
HH Income x 10^{-6}	0.056	(0.062)
HH Sav. & Inv. x 10-6	0.059	(0.237)

Source: PSED Wave1, Economod
Number of observations is 1,052.

The sample consists of 1,052 observations. Approximately 63 percent of the sample are entrepreneurs, and 92 percent hold jobs, regardless of being involved in a start-up. The average age is 40 years, which puts the respondents right in the middle of their life-cycle earnings profile. The average number of years of paid work experience is 17, including both full- and part-time jobs. The education variable is constructed in terms of levels of schooling completed, the lowest being up to eighth grade and the highest LLB, MD, PhD, or EDD degree. The average respondent has some college experience.

[7]Sleeping is given the second most time.

Table 2 Time Allocation in a Workday (hours)

	Mean	SD
Entrepreneurs		
All work for pay, including travel	6.96	4.05
Working on a new business start-up	2.05	2.77
Reading, TV, sports, recreation, hobbies etc.	1.49	1.33
Personal time with spouse, others	1.69	1.36
Control group		
All work for pay, including travel	7.13	3.98
Working on a new business start-up	-	-
Reading, TV, sports, recreation, hobbies etc.	1.89	1.46
Personal time with spouse, others	1.79	2.00

Source: PSED Wave1
Sleeping is given the second most time during workdays

5.1 Are Entrepreneurs Wealthier?

Table 3 gives summary statistics for household income and household wealth for nascent entrepreneurs and the control group separately. Household income includes all sources of income such as work, government benefits, and pensions before taxes in the previous year. Income is in relative figures. The difference between the average household incomes of the two groups is not statistically significant at the 1 percent level.

Table 3 Household Income and Wealth

	Mean	Median	SE
Household Income	55,869	40,230	1,921
Nascent Entrepreneurs	56,883	42,800	2,771
Control Group	54,147	31,078	2,150
Household Wealth	205,967	55,759	20,294
Nascent Entrepreneurs	215,308	59,220	29,237
Control Group	190,097	49,103	22,854

Source: PSED Wave1

The PSED questions on net worth are modeled after the questions from the Survey of Consumer Finances. Three separate approaches are used for the collection of data on house-

hold net worth. First, respondents report a wealth component measured in four categories: current value of home; mortgages or land contracts on the home; tangible assets, savings, and investments (current value of stocks, bonds, mutual funds, saving accounts, checking accounts, retirement accounts, etc.); and other debts and land contracts. Second, respondents report a single wealth value, which is an approximation of the current household net worth. Third, categorical wealth values are reported. Significantly more variation is observed in the household wealth. The average and median levels of wealth are higher for entrepreneurs than for members of the control group. Also, the average amount of savings and investments from Table 1 is $59,000, which is approximately one-fourth of the household wealth.

5.2 Where Are The Part-Timers?

The economic sector of the start-ups covered by the PSED is very similar to the existing US business with employees. Gartner et al. (2004, p. 248) compare the 1997-1999 PSED sample with the US business population. They use two sources of business description by sector: the population of all firms (5.5 mil. in 1998) with employees developed by the Census Bureau of the Department of Commerce; and the annual counts of business tax returns assembled by the Internal Revenue Service.

Gartner et al. show that there is a correspondence between the three sources, and that in most cases the sector percentage falls in the range between the employee firms and the tax return data. This result seems to be appropriate since the PSED covers mainly sole proprietorships and firms that will hire employees in the future. The only exceptions are retail trade and information sectors where the number of start-ups is disproportionately high; and the finance and insurance, health care and social assistance, and the accommodation and foot services with a low percentage of start-ups reported. These differences come from the fact that the PSED covers essentially start-ups, while the other two descriptions reflect operating businesses. In general, however, the start-up efforts seem to reflect the existing business activity.

I divide the sample of nascent entrepreneurs in the PSED into two groups based on the time they spend in their start-ups. Those who devote 35 hours per week and more are full-time entrepreneurs. The rest form the group of the part-timers. Similarly to Gartner et al., I use both the US Standard Industrial Classification (SIC 1987) and the North American Industry Classification System (NAICS 1997). The results are presented on Figure 3 and Figure 4 in Appendix[8].

The differences in sector orientation between full- and part-time entrepreneurs are statistically significant at the 5 percent level in agriculture, forestry, and fishing; construction; manufacturing; transportation and communication; and business services. There are relatively less part-timers than full-time entrepreneurs in agriculture, construction, and transportation, while the opposite holds for business services and manufacturing. This result supports the prediction of my theoretical model. Manufacturing is a sector where returns need a longer period of time.

Figure 3, where the start-ups are plotted across 20 sectors provides a confirmation of the above discussion. The differences in agriculture, forestry, and fishing; construction; manufacturing are even more distinctive. In addition, there are two more sectors where the number of part-timers is disproportionately high: professional, scientific, and technical services; and information.

6 Empirical Results

For comparison, I first estimate the model without the instrumental variable included. The results presented in Table 4 show that the coefficient on wealth is zero and not statistically significant at the 5 percent level. The transformation of results is done at both the mean and the median.

I next present a two-stage estimation. The estimates from stage one are reported in

[8]There are only 9 sectors on Figure 4, even though under the SIC 1987 classification there are 10 of them. Since there are no start-ups in Mining, I do not show it on the graph.

Table 5. The dependent variable, household net worth, is regressed on the monthly change in S&P500, household savings and investments, an interaction term of the monthly changes and savings and investments, number of outside labor market activities (start-ups not included), dummy variables for jobs, race, and gender; years of education, experience, and age; and dummies for marriage and divorce.

**Table 4 Probit Estimates of Entrepreneurial Propensity*
No IV included**

Variable	(1) at the mean	(2) at the median
Wealth	0.000	0.000
	(0.000)	(0.000)
Activities	-0.106*	-0.111*
	(0.029)	(0.031)
Job	0.181*	0.184*
	(0.050)	(0.050)
White	-0.131*	-0.141*
	(0.031)	(0.034)
Male	0.143*	0.143*
	(0.035)	(0.035)
Education	0.011	0.011
	(0.009)	(0.009)
Married	0.107*	0.112*
	(0.041)	(0.043)
Divorced	0.057	0.061
	(0.059)	(0.063)
Experience	0.004***	0.005***
	(0.002)	(0.002)
Age	-0.009*	-0.009*
	(0.002)	(0.002)
Number of obs. is 1053		
Log Likelihood = -640.21473		
chi2(11) = 109.74		
Prob > chi2 = 0.0000		

Standard errors in parenthesis.
*Significant at the 1 percent level.
**Significant at the 5 percent level.
***Significant at the 10 percent level.

The set of instruments used in this study meets the standard of Staiger and Stock. In the first stage of IV estimation, the hypothesis that the coefficients on the instruments are

jointly equal to zero is rejected. The instruments have an F-statistics equal to 25.08 and $\triangle R^2 = 0.3428$.

Table 5 Stage One IV Estimates

Variable	
Activities	-14709.210
	(-31769.090)
Job	7721.165
	(43225.170)
White	-35213.420
	(38151.970)
Male	14558.100
	(24943.930)
Years of education	-4019.279
	(11587.030)
Married	-25611.850
	(29080.690)
Divorced	-85311.270*
	(31713.730)
Years of experience	4236.644***
	(2330.750)
Age	-2982.428***
	(1792.371)
Monthly change in S&P500	497.669**
	(239.324)
S&P500 x HH Sav. & Inv.	-0.020***
	(0.012)
HH Savings & Investments	3.477*
	(1.113)
HH Savings & Investments^2	0.000*
	(0.000)
Constant	170124.400
	(131837.400)
Number of observations	1,048
F(13, 1034)	25.08
R-squared	0.3428
Prob > F	0.0000

Standard errors in parenthesis.
Dependent variable: Household Net Worth.
*Significant at the 1 percent level.
**Significant at the 5 percent level.
***Significant at the 10 percent level.

All the coefficients on the instruments are of the expected signs. The coefficient on the monthly change in S&P500 is statistically significant at the 5 percent level and is robust to

different specifications. I take the fitted residual from the first stage and estimate a probit equation in the second stage.

Probit estimates of the effect of wealth on the propensity to become an entrepreneur are presented in Table 6. The coefficient on the residual is not statistically significant, which is an indication that wealth is exogenous given that the instruments are exogenous and correct. Similarly, the coefficient on wealth is not significantly different from zero. Thus, wealth has an insignificant effect on the propensity to become an entrepreneur. This is not to say that no entrepreneur is credit constrained. Instead, the result applies to the marginal entrepreneur.

Table 6 Probit Estimates of Entrepreneurial Propensity

Variable	(1) at the mean	(2) at the median
Wealth	0.000	0.000
	(0.000)	(0.000)
Activities	-0.104*	-0.109
	(0.029)	(0.031)
Job	0.174*	0.177
	(0.049)	(0.049)
White	-0.132*	-0.142
	(0.031)	(0.033)
Male	0.148*	0.147
	(0.035)	(0.035)
Education	0.013	0.013
	(0.009)	(0.009)
Married	0.109*	0.113
	(0.041)	(0.043)
Divorced	0.056	0.060
	(0.061)	(0.063)
Experience	0.005**	0.005
	(0.002)	(0.003)
Age	-0.009*	-0.010
	(0.002)	(0.002)
Fitted residual	0.000	0.000
	(0.000)	(0.000)

Number of observations 1048
Log Likelihood = -636.87496
Wald chi2(11) = 110.53
Prob > chi2 = 0.0000

Standard errors in parenthesis.
*Significant at the 1 percent level.
**Significant at the 5 percent level.
***Significant at the 10 percent level.

From the rest of the covariates included in the probit estimation, only education and the dummy variable for divorce are not statistically significant. One important result of the probit equation is the confirmation that people who already work are more likely to be involved in start-ups. Whites are less likely to become entrepreneurs, confirming results from earlier studies. Age has a negative effect, which can be explained by the age profile in the sample. Sample age profile is shown on Figure 7 in Appendix. Married people and those with more experience are more likely to become entrepreneurs.

I further compare the group of part-time versus full-time entrepreneurs. In my sample of 1052 individuals, 663 are entrepreneurs, and from them 469 are part-timers and only 194 are full-time entrepreneurs. These are people who spent all of their time in their businesses. I compare the two groups in terms of demographic characteristics, household networth, savings and investments, and income. It turns out that the differences are not significantly different from zero. The significance of this result is that it comes as a confirmation of my previous findings that initial wealth appears to have an insignificant effect on the propensity to start a new business for the marginal entrepreneur.

7 Concluding Remarks

I examine the effect of initial wealth on the tendency to participate in a business start-up for part-time entrepreneurs and argue that wealth does not significantly affect the propensity to become an entrepreneur. I develop a model of entrepreneurial choice where one can hold an outside paid job while also being involved in a start-up. Individuals make joint decisions of how much capital to invest and what proportion of time to spend in business.

Since part-time entrepreneurs are people who work a regular wage job some of the time and work at their own businesses the other part of the time, one hypothesis for the existence of part-time entrepreneurship is that people are credit-constrained. They would like to borrow enough to build their businesses and survive while the enterprise is still small. If they cannot borrow, the only way they can get money to pay their bills is to work at a

regular job. If credit constraints are the problem, then perhaps the economy is generating less entrepreneurship than would be ideal.

To examine the importance of credit constraints, I estimate a reduced-form probit model. Under the assumption that wealth and ability are not correlated, the probability of starting a new business and wealth would be positively correlated if and only if there are credit constraints. I deal with the potential wealth endogeneity by proposing a new method for instrumenting wealth. I use month-to-month changes in the Standard & Poor 500 stock market index that serve as a source of assets variation exogenous to entrepreneurial decisions. I use a new and unique data set that provides detailed information on how nascent entrepreneurs divide their time between their own businesses and other jobs. The data follows both entrepreneurs and start-ups.

My empirical findings show that part-time entrepreneurs do not appear to be constrained. This is not to say that no entrepreneur is credit constrained. It might be that a lot of part-time business owners operate in less capital intensive sectors. Instead, the result points to the effect of wealth on the marginal entrepreneur.

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APPENDIX 1

Proof of Proposition 1:

The entrepreneur's desired investment and time spent in the start-up are obtained by maximizing his net income with respect to k and δ.

$$\underset{0\leqslant\delta\leqslant 1,\ k\geqslant 0}{max}\ \pi(k,\delta;\theta) = \theta k^{\alpha}\delta^{\beta} + r(z-k) + w(1-\delta)$$

The Lagrangian for this maximization problem is:

$$\pounds = \theta k^{\alpha}\delta^{\beta} + r(z-k) + w(1-\delta) - \mu_1(\delta - 1) + \mu_2\delta + \mu_3 k.$$

The first-order and the complementarity slackness conditions are:

$$\frac{\theta\alpha k^{\alpha}\delta^{\beta}}{k} = r,$$

$$\frac{\theta k^{\alpha}\beta\delta^{\beta}}{\delta} = w + \mu_1,$$

$$-\mu_1(\delta - 1) = 0,\ \ \mu_1 \geqslant 0,$$

$$\mu_2\delta = 0,\ \ \mu_2 \geqslant 0,$$

$$\mu_3 k = 0,\ \ \mu_3 \geqslant 0,$$

$$\delta \leqslant 1.$$

The optimal solution can be an interior solution when individuals choose to be part-time entrepreneurs, or a corner solution when they are either full-time entrepreneurs or wage workers. Hence, there are three possible outcomes.

Case 1: Interior solution

In this case $\mu_1 = 0$ and the necessary conditions for the optimal amount of capital and

relative time spent in start-up are:

$$\alpha \frac{\theta k^{\alpha} \delta^{\beta}}{k} = r,$$
$$\beta \frac{\theta k^{\alpha} \delta^{\beta}}{\delta} = w$$
$$\delta < 1.$$

Thus, the optimal factor input ratio is $\frac{k^*}{\delta^*} = \frac{\alpha}{\beta}\frac{w}{r}$ and the net income can be rewritten as:

$$\pi(k^*, \delta^*; \theta) = (1 - \alpha - \beta)\theta k^{*\alpha} \delta^{*\beta} + rs + w.$$

Since the production function exhibits decreasing returns to scale ($\alpha + \beta < 1$), k^* and δ^* are determined as:

$$k^* = \theta^{\frac{1}{1-\alpha-\beta}} \left(\frac{\alpha}{r}\right)^{\frac{1-\beta}{1-\alpha-\beta}} \left(\frac{\beta}{w}\right)^{\frac{\beta}{1-\alpha-\beta}}, \tag{21}$$

$$\delta^* = \theta^{\frac{1}{1-\alpha-\beta}} \left(\frac{\alpha}{r}\right)^{\frac{\alpha}{1-\alpha-\beta}} \left(\frac{\beta}{w}\right)^{\frac{1-\alpha}{1-\alpha-\beta}}. \tag{delta_A1}$$

If the production function has constant returns to scale ($\alpha + \beta = 1$), the optimal factor input ratio is still equal to $\frac{\alpha}{\beta}\frac{w}{r}$. However, the optimal levels k^* and δ^* are not determined and there is no rent under the optimal factor input ratio. In this case, $\pi(k^*, \delta^*; \theta) = rs + w$, or the entrepreneurial income would be the same as the wage worker's income.

Both k^* and δ^* are nonnegative, with the exception of the case when θ is zero. Thus, to insure that all conditions hold and that (21) and (**??**) form the interior solution of the maximization problem, δ^* must satisfy the condition $0 < \delta^* < 1$. From (**??**), $0 < \theta^{\frac{1}{1-\alpha-\beta}} \left(\frac{\alpha}{r}\right)^{\frac{\alpha}{1-\alpha-\beta}} \left(\frac{\beta}{w}\right)^{\frac{1-\alpha}{1-\alpha-\beta}} < 1$, or

$$0 < \theta < \left(\frac{r}{\alpha}\right)^{\alpha} \left(\frac{w}{\beta}\right)^{1-\alpha}.$$

The entrepreneurial net income is:

$$\pi(k^*, \delta^*; \theta) = (1 - \alpha - \beta)\theta^{\frac{1}{1-\alpha-\beta}} \left(\frac{\alpha}{r}\right)^{\frac{\alpha}{1-\alpha-\beta}} \left(\frac{\beta}{w}\right)^{\frac{\beta}{1-\alpha-\beta}} + rz + w,$$

with a positive rent from entrepreneurial ability

$$(1-\alpha-\beta)\theta^{\frac{1}{1-\alpha-\beta}}\left(\frac{\alpha}{r}\right)^{\frac{\alpha}{1-\alpha-\beta}}\left(\frac{\beta}{w}\right)^{\frac{\beta}{1-\alpha-\beta}}>0$$

at the optimal levels of k and δ.

Case 2: Corner solutions

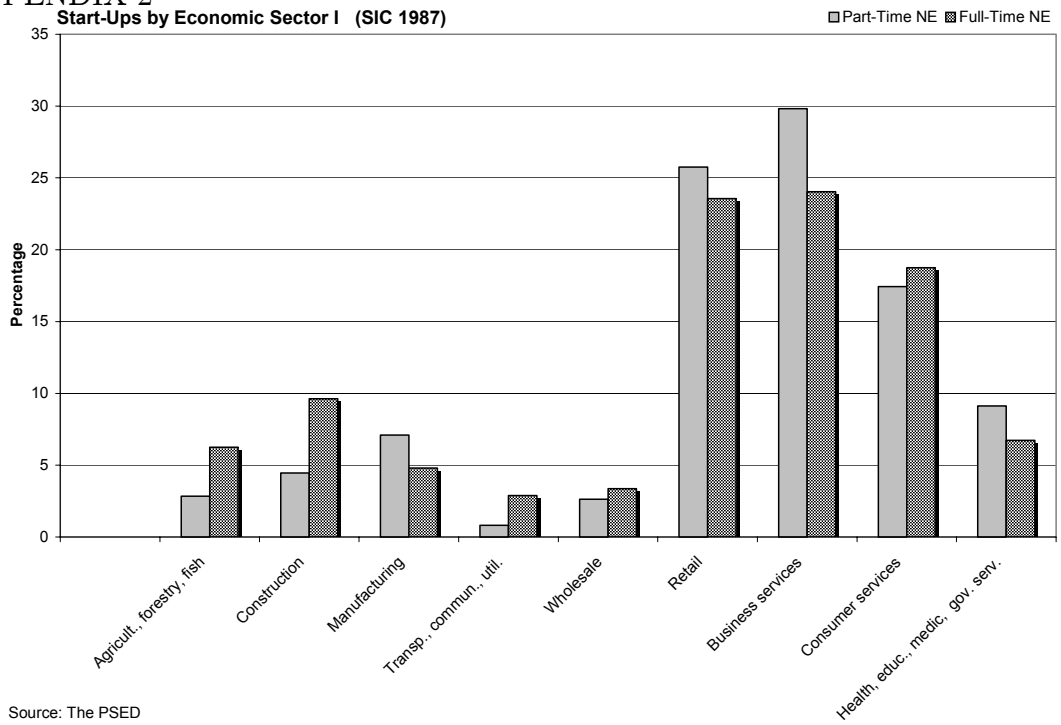
When $\mu_1 \neq 0$, $\delta = 1$. Individuals choose full-time entrepreneurship. The net income is $\theta k^{\alpha}\delta^{\beta} + r(z-k)$, and the optimal solution becomes $k^* = \left(\frac{\theta\alpha}{r}\right)^{\frac{1}{1-\alpha}}$ and $\delta^* = 1$. In this case, $\theta \geqslant \left(\frac{r}{\alpha}\right)^{\alpha}\left(\frac{w}{\beta}\right)^{1-\alpha}$.

Finally, when $\theta = 0$, individual become wage workers only. In this case, $\delta = 0$ and the net income for a full-time wage worker is $w + rz$.

This model generalizes the entrepreneurial choice model developed by EJ and Xu. The solution in the general case can be summarized in the following way:

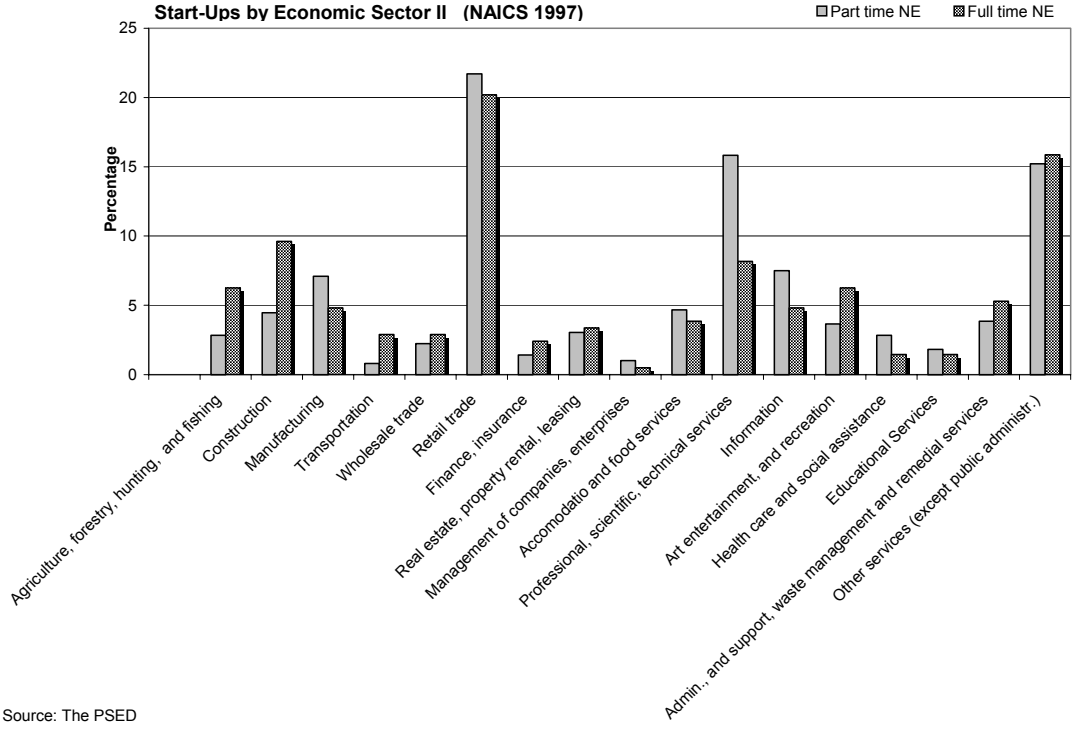
$$\begin{aligned}
\text{Full-time entrepreneur for} \quad & \theta \geqslant \left(\frac{r}{\alpha}\right)^{\alpha}\left(\frac{w}{\beta}\right)^{1-\alpha} \\
\text{Part-time entrepreneur for} \quad & 0 < \theta < \left(\frac{r}{\alpha}\right)^{\alpha}\left(\frac{w}{\beta}\right)^{1-\alpha} \\
\text{Wage worker for} \quad & \theta = 0
\end{aligned}$$

APPENDIX 2



Source: The PSED

Figure 3



Source: The PSED

Figure 4

APPENDIX 3

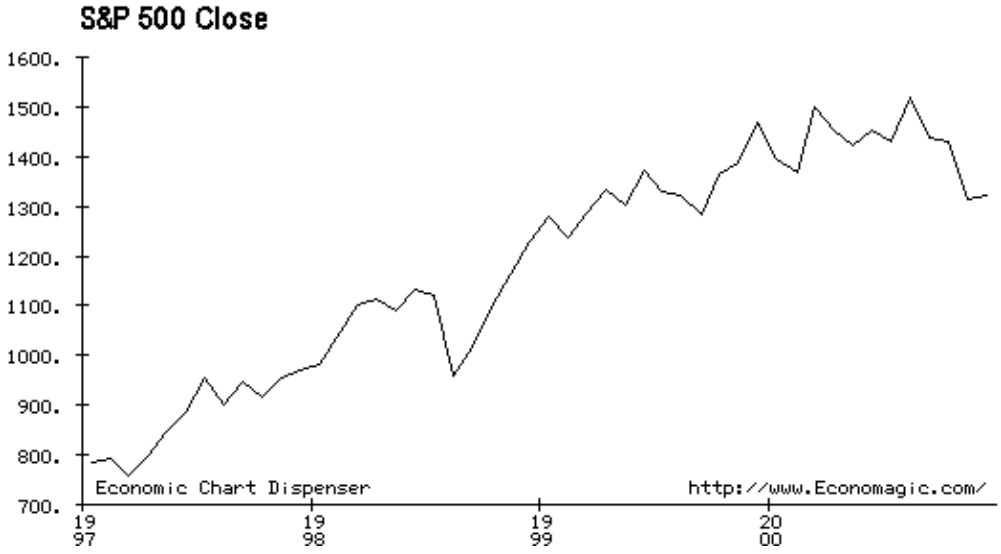


Figure 5

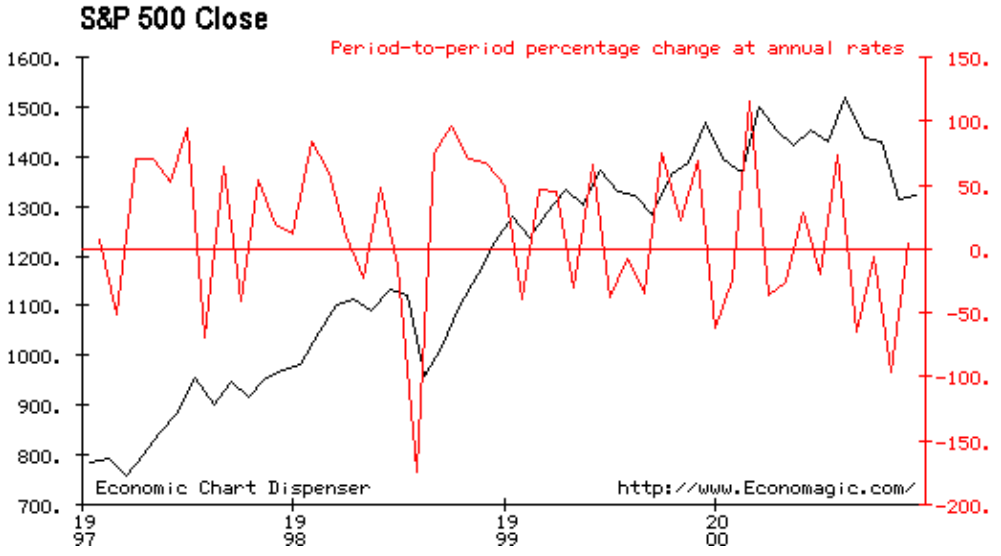


Figure 6

APPENDIX 4

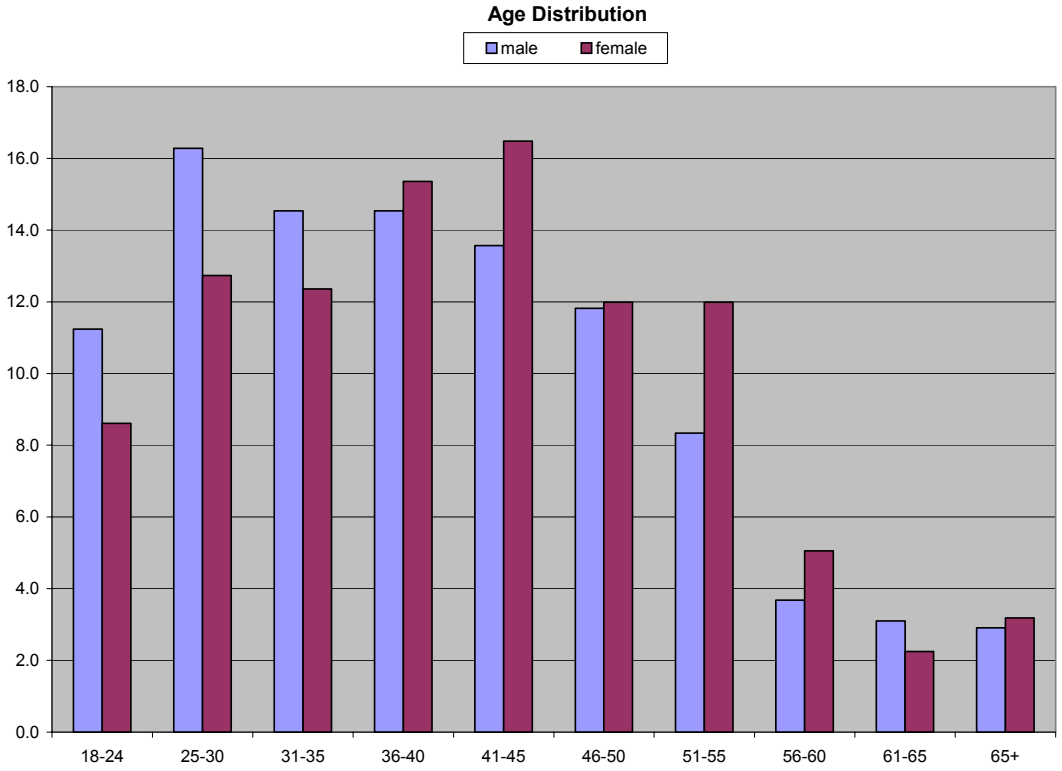


Figure 7